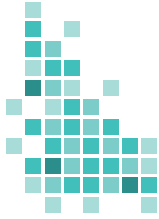


IDAHO GLOBAL ENTREPRENEURIAL MISSION
2015 ANNUAL REPORT



IGEM



IGEM

The Idaho Global Entrepreneurial Mission (IGEM) is a unique program that invests public funds in university research initiatives that convert into economic development for the state. The IGEM grant program uses a three pronged approach to support a statewide entrepreneurial and commercialization pipeline to bring to market advances in agribusiness, computer science, medical and veterinary research, advanced

energy initiatives, and other areas that are equally vital to the state's economy. In the first three years of operation, IGEM has been successful by advancing important research capacity, funding research projects that position Idaho's industries in new and profitable markets, and propelling innovation within the state. This annual report provides a succinct update on the IGEM program, its funded projects, and successes.

IGEM PROVIDES THREE DISTINCT FUNDING OPPORTUNITIES:

IGEM – COMMERCE \$1 MILLION

Managed by the Idaho Department of Commerce under the direction of the IGEM Council.

Funds research ventures where industry and university partnerships work together to bring viable products and technologies to market.

IGEM – HERC \$2 MILLION

Managed by the State Board of Education and administered by the Higher Education Research Council.

Invests funds to support infrastructure and advance key capacities at Idaho's research universities.

IGEM – CAES \$2 MILLION

Managed by the SBOE and administered by the Center for Advanced Energy Studies.

Leverages the university partnerships with the Idaho National Lab to fund the CAES initiative which advances energy studies at Idaho's research universities.



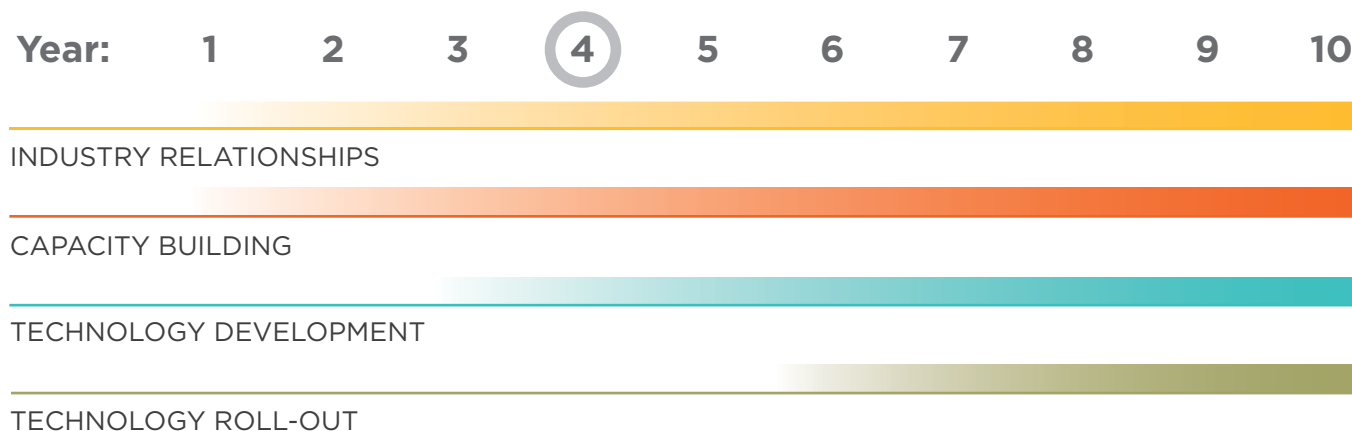
The IGEM grant program funds research to be commercialized, where university investigators and private sector businesses partner to bring viable technologies to market. By funding university research that can advance private sector products and services produced in Idaho, IGEM is a powerful resource in the growth of Idaho's economy. Through its support of commercialization partnerships, IGEM makes a strategic investment in developing new business ventures, advancing next generation products, creating high-value jobs, and strengthening the research capacity of Idaho's universities.

At the helm of the IGEM program is the IGEM Council, a Governor-appointed body whose diverse backgrounds consist of the brightest business, research, policy, strategy, and financial minds in the state. This 12 member council thoroughly vets all IGEM applications to mitigate risk and maximize the return on investment for these

publicly-funded grants. The council's fiscal stewardship and strategic leadership advances the program's goals of commercializing cutting-edge research throughout the state, leading to high end job creation, and an ever-advancing economy.

The chart below provides a broad overview of the IGEM program spectrum. It begins with building strong relations with Idaho industries and seeking opportunities where IGEM-funded commercialization research is beneficial both for the industry partner and the university. It also identifies the need to build capacity and internal infrastructure in order to advance specific industries forward such as AgTech, AeroTech, MedTech, VetTech, EdTech, and many others.

IGEM is beginning its fourth year. The following report provides an update on past and current projects.





N-E-W Tech

Nutrient - Energy - Water Innovation
WATERSCAPE 2025

IGEM - COMMERCE COMMERCIALIZATION AWARDS

IGEM - Commerce has funded 14 projects through FY2015; 3 in FY2015, 4 in FY2014, and 7 in FY2013 totaling over \$2.7 million invested in commercialization research.

FY2015 GRANT AWARDS

DATA ANALYTICS

Boise State University

Grant Amount: \$343,072

Boise State University is working with Simplot to develop a data analytics solution for agronomic decision-making based on historic farm and crop yield data. The goal of this project is to leverage Simplot's existing data to give growers new tools and resources they need to optimize their yields. Researchers are automating the process of matching the multi-spectral photosynthetic images for Simplot so they can be used to produce predictive models for their network of growers. A collaborative research agreement with affirmed licensing has been executed between Simplot and Boise State University.

EXPANDING PRECISION AGRICULTURE MARKET OPPORTUNITIES WITH UNMANNED AIRCRAFT SYSTEM SENSORS

Idaho State University

Grant Amount: \$179,755

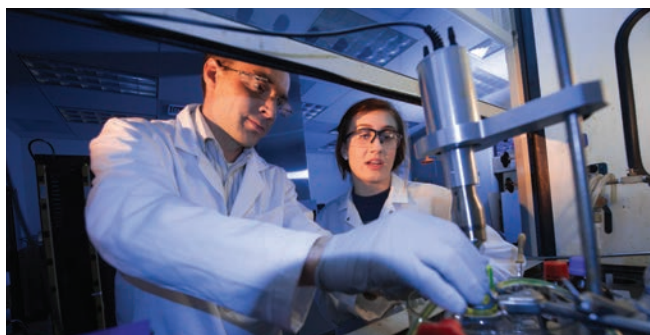
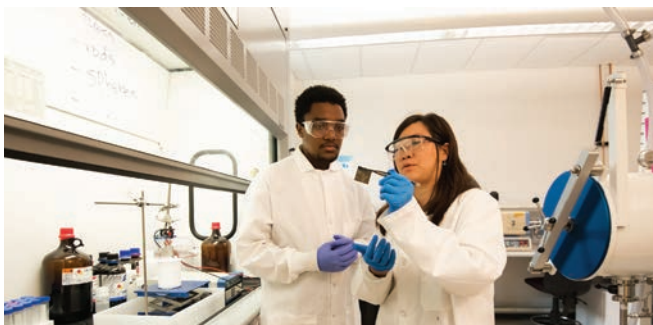
This project utilizes hyperspectral imaging via Unmanned Aircraft Systems (UAS) to advance precision agriculture opportunities. ISU and their industry partner, Simplot, see the opportunity to leverage advanced research and development in remote sensing applications in combination with multiplatform data collection through UAS. Researchers are able to clearly distinguish between healthy and diseased vegetation.

N-E-W TECH™: INNOVATION AT THE NUTRIENT, ENERGY, WATER NEXUS

University of Idaho

Grant Amount: \$427,173

This project validates and brings to scale a new reactive filtration water treatment technology. The new technology removes biological contaminants in the water, using treated biochar and a catalytic oxidation process that destroys most compounds of concern such as hormones and pharmaceuticals. Blue Water Technologies partnered with the University of Idaho in bringing to scale a small mobile pilot plant that demonstrates the effectiveness of this technology.



IGEM - COMMERCE PROJECTS IN PROGRESS

CANINE HIP IMPLANT

Boise State University

FY2014 Grant Amount: \$110,454

An innovative hip implant for canines is being developed by an Idaho-based partnership between veterinary surgeons at WestVet, scientists at Boise State University, and engineers and distributors from MWI. A new implant, the Bionic Hip System™, has been developed by MWI to improve the standard of care for treating hip osteoarthritis by reducing cost, improving canine mobility, and lowering complications. In this project, Boise State is characterizing the mechanical performance of the implant and WestVet anticipates using the new system in dogs within six months to a year, if testing results continue to be positive.

2E-HEXENAL FUNGICIDE

University of Idaho

FY2014 Grant Amount: \$296,917

At the University of Idaho, researchers are testing an organic compound called 2E-hexenal as a fungicide for stored potatoes. A new approach to eradicate fungi by applying 2E-hexenal in a gaseous state would be industry changing. A patent has been issued in the US, with pending patents in Mexico, Europe, Canada, Chile, and Brazil. U of I has partnered with Sun Rain LLC, Agri-Stor Inc., and AMVAC to study the effectiveness of this fungicide in post-harvest tubers.

IGEM – COMMERCE COMPLETED PROJECTS

RISE ANALYTICS

Idaho State University

FY2014 Grant Amount: \$300,000

Idaho State University partnered with ON Semiconductor for analytical research in the development and improvement of semiconductor products. Due to the acquisition of the Scanning Electron Microscopy and Energy Dispersive Spectroscopy (SEM/EDAX) equipment, the Department of Energy has invested over \$6.5 million in grants to Idaho State University. The equipment has fostered collaboration between ISU and Advanced Ceramic Fibers, ON Semiconductor, and the University of Notre Dame. This equipment has the potential to help all Idaho semiconductor companies in product development.

SURFACTANT SOLUTIONS

Boise State University

FY2014 Grant Amount: \$265,000

Boise State University partnered with BHS Specialty Chemical Products to create renewable chemicals by converting oils into surfactants for use in products marketed to industrial food processing, personal care, and petroleum industries. Researchers were successful in creating surfactants from pure oil feedstocks, as well as developing a method to make surfactants from high grade vegetable oil waste. Likewise, researchers were able to use low grade vegetable oils from food production facilities as feedstock for surfactant synthesis. Boise State University and BHS Specialty have joined into a research collaboration agreement, with the industry partner pursuing patents on this project.

NANOFABRICATION INFRASTRUCTURE SUPPORT

Idaho State University

FY2013 Grant Amount: \$250,000

The project allowed for the acquisition of a Dualbeam-Nanomachining Center. The Dualbeam system provides both high resolution imaging and nano-machining capabilities in a single component. This tool enables the university to provide ultra-precise machining and nanofabrication capabilities that meet the needs of their semiconductor industry partners. The accessibility to this machinery provides ISU students with hands-on, cutting-edge training, uniquely preparing them as they enter the workforce. To date, ISU has received over \$3.5 million in separate funding, resulting from this IGEM sponsored project.



HIGH SPEED DIGITAL PACKAGE MEASUREMENT & MODELING FOR NEXT GENERATION MEMORY MODULES

University of Idaho

FY2013 Grant Amount: \$150,000

Partnered with Micron, this project allowed for speedier development and design on next generation memory modules with the acquisition of the Vector Network Analyzer. The acquisition of the Vector Network Analyzer, not only helped Micron but it also prepares U of I students with hands-on education on the latest industry equipment. Additionally, the Micron Foundation gifted \$1 million to U of I to fund an endowed professorship in microelectronics in the College of Engineering. This gift will support U of I's efforts to better position itself as a leader in microelectronics education and research.



INNOVATIVE PESTICIDE APPLICATION TECHNOLOGY SYSTEM

University of Idaho

FY2013 Grant Amount: \$46,146

The project allowed for field tests to be conducted to quantify the effectiveness of a new pesticide spraying technology. GenZ Technology, the industry partner, learned from these field tests that the new spraying technology performed better than existing technology. This new pesticide application system has been used on strawberry and lettuce crops. This project has raised over \$2 million in capital from angel investors for the industry partner and has also hired 8 new employees.

AUTOMATED QUANTITATIVE DETECTION OF E.COLI O157:H7 AT BEEF PROCESSING FACILITIES

University of Idaho

FY2013 Grant Amount: \$78,076

The project examined if there was a better process to detect and determine the strains of E.Coli within the beef processing system. While the project was successful in decreasing the detection time, the new process is not

sufficient for commercial use at a beef processing plant. The process did recognize six strains that are considered adulterants in fresh ground beef products. Additionally, beef trim contaminated with E.coli O157:H7 could be identified in approximately 18 hours, which is about 24 hours faster than other generic methods.

COMMERCIALIZATION OF NEW AQUATIC ANIMAL HEALTH PRODUCTS

University of Idaho

FY2013 Grant Amount: \$124,021

The project allowed for trials on a new fish vaccine and a probiotic feed additive aimed at reducing fish losses in aquaculture facilities due to Cold Water Disease (CWD). The iron limited vaccine yielded successful results. This formula work will be used for final regulatory approval with the Food and Drug Administration. Additional funding was awarded in FY2016 to assist the University of Idaho and the pharma partner in their pursuit of commercializing this vaccine.

DETERMINE COMMERCIAL VIABILITY OF MICROBIAL INDUCED CALCITE PRECIPITATION (MICP)

University of Idaho

FY2013 Grant Amount: \$114,864

The project allowed an assessment to be made on the viability of MICP, a process that uses microorganisms already present in the soil to form calcite. A new Idaho Company, BioCement Technologies, Inc., has been

created as a result of this new product and a license of this technology has been negotiated with the University of Idaho. In addition to receiving IGEM grant funds, this project has also received National Institute of Health (NIH) Small Business Investment Research (SBIR) funding. The SBIR Phase 1 grant was \$53,968 for a 6 month study to reduce the mobility of lead in soils at Kellogg, Idaho sites. In addition to the SBIR, an additional \$100,000 has been raised in seed funding. This technology has been patented in the US, New Zealand, Australia, and Canada and BioCement Technologies is developing strategic partnerships to expand its commercial applications.

CONDUCT PRECLINICAL STUDIES ON POTENTIAL ANTICANCER AGENTS

Boise State University

FY2013 Grant Amount: \$80,986

The project focused on the analogs of doxorubicin and mitomycin C, two compounds that have an important role in the treatment of a variety of cancer types. Use of these analogs has declined due to side effects, including myelosuppression and the onset of irreversible acute cardiotoxicity. Research efforts to gain knowledge on doxorubicin and mitomycin C's mechanism of toxicity have provided tangible results. Initial studies (in vitro) have shown that Aclacinomycin A (Acm) analogs in both classes were 170% more effective. Anti-Cyclin analogs (ACA) were 35,000% more effective. They have also proven effective against sarcomas. Research discoveries were published in the scientific journal, Bioorganic & Medicinal Chemistry. With its partnership with Boise State, Gem Pharmaceuticals is continuing to explore combination chemotherapy with GPX-160 and other anticancer drugs.

IGEM - HERC

IGEM - HIGHER EDUCATION RESEARCH COUNCIL (HERC)

IGEM - HERC funds are used to support Idaho public institutions of higher education in research and development of projects that foster expertise, products, and services resulting in state economic growth. Priority is granted to those proposals that can show a strong collaborative effort among institutions, as well as the private sector or exhibit high potential for near-term technology transfer to the private sector. In FY2016, the Higher Education Research Council (HERC) awarded its second round of new IGEN - HERC projects. IGEN - HERC funded projects may receive funding for up to three years, contingent on annual review and satisfactory progress toward approved performance measures.

The institutions report to HERC each year on the status of their projects, including progress toward key objectives, budget expenditures, economic impact and commercialization potential. The awards granted in FY2016 included a new three-year award for the Boise State University Computer Science Program, another three-year award to Boise State for Enhancing Capabilities in Nanotechnology and Microfabrication, and a one year award for Idaho State University (ISU) for wide band gap and harsh environment semiconductors capability enhancements.

HERC awards are granted through a competitive process that is open to each of the three research institutions. The process incorporates an independent review of proposals and an evaluation component for identifying the project success and economic benefit to the state.

Performance measures established for project accountability are specific to each award and are objective, measurable, and realistic. Additional funding for awarded projects after FY2018 will be based on the successful completion of the competitive process.

Boise State University: Computer Science at Boise State University—An Investment in Idaho's Future (\$700,000)

The focus of the Boise State University project is on accelerating the growth in the areas of Cyber Security and Big Data to expand research, industry collaboration, and teaching capacity. The Computer Science Department continues to increase its formal and informal connections with industries, and the IGEN hires are integral to growing partnerships with those industries. The strategic faculty hires that were made in the first round of HERC funding will be key in the progress of this project.

Boise State has made significant additional infrastructure enhancements to help support the faculty recruitment and retention, receiving a \$1 million grant from the Idaho Department of Labor along with \$280,000 in matching grants from eight industry partners. This grant and match allowed Boise State to hire three additional lecturers and support staff. These hires are focused in the areas of Big Data, Cyber Security, Human Computer Interaction, and Computer Science Education research, along with the capability to create a Big Data track in both the Masters and PhD programs.

As part of the previous IGEM - HERC grant (FY2013-FY2015), the Computer Science Department restructured the first two undergraduate Computer Science classes into three classes to allow students more time to absorb the material. Along with other strategies, this has led to increased student retention in the freshmen computer science course from a 65% retention rate to an 85% retention rate over the last two years.

Idaho State University: Wide Band Gap and Harsh Environment Semiconductor Capability (\$700,000)

Wide band gap and harsh environment semiconductors are currently on the cutting edge of research in materials science, solid state physics, and electrical engineering fields around the globe. The focus of this project is to bring new jobs and economic growth to Idaho while providing the ability to grow as an industry center in this area. The material systems for this project hold several key scientific and engineering advantages over existing semiconductor material systems with the ability to operate with higher efficiencies, higher currents, and higher outputs; these materials hold a strategic focus in energy harvesting and green energy solutions.

This project will unite all stages of advanced wide band gap semiconductor device fabrication, as well as extreme environment semiconductors with a special emphasis on the fundamental building blocks of semiconductor growth. Additional capabilities will be added to meet the growing needs for bulk wide band gap semiconductor materials, as well as epitaxial growth of novel band gap engineered semiconductor films and establish a demonstration pilot scale production capability.

Boise State University: Enhancing Capabilities in Nanotechnology and Microfabrication at Boise State (\$500,000)

This project is focused on upgrading the materials characterization and microelectronic processing capability in the Idaho Microfabrication Laboratory (IML) in support of technology development and economic growth needed in the State of Idaho. This project will expand expertise in the emerging research areas of flexible and printed electronics, thin-film and 2D materials, and neuromorphic computing.

Economic growth in this industry is enabled by innovative research and development using advanced processing techniques to create new materials, structures, and devices. These new products have broad impacts within industries as diverse as agriculture, medicine, transportation, and energy. This project will enhance the capabilities of the IML and nanotechnology fabrication at Boise State, which will in-turn educate the current and future workforce, offer programs that will support local companies, and conduct leading edge research that attracts external funding. Idaho companies who are partnering with Boise State on this project are interested in a wide variety of capabilities. The results of this project would allow these companies to perform research and development activities that would otherwise be too costly. Partnering companies will also have the potential to expand their business by improving the performance or increasing yields of existing products in addition to developing completely new products.



IGEM - CAES

The Center for Advanced Energy Studies is a research and education consortium between the Idaho National Laboratory, Boise State University, Idaho State University, University of Idaho, and University of Wyoming.

THE FUTURE OF GEOTHERMAL ENERGY

CAES is at the forefront of one of five groups pursuing the development of Enhanced Geothermal Systems (EGS) for the U.S. Department of Energy's Frontier Observatory for Research in Geothermal Energy (FORGE) initiative. Known as the Snake River Geothermal Consortium, the team is working to refine and prove EGS, a system where water is pumped into hot, fractured rock about 8,000 to 12,000 feet deep, heated by the earth, then brought back to the surface to generate energy. Although CAES projects involve two or more CAES institutions collaborating, the FORGE project is unique because all five CAES institutions are participating along with 32 other national laboratories, universities, and industry partners. Phase 1 studies are now underway and the team is vying to be one of three teams selected to move on to Phase 2 in summer 2016.

CAES FOOD-ENERGY-WATER (FEW) INITIATIVE ADDRESSES GLOBAL NEEDS

By 2050 the world's population is expected to reach 9.6 billion and food production must increase to meet that demand. Food processing requires large amounts of water and energy and is central to the region's agricultural economy. Regional industries have major challenges in updating food processing infrastructure, reducing energy demand, minimizing impacts on the environment, and conserving water. The University of Idaho-led Center for Advanced Energy Studies Food-Energy-Water Initiative is working on solutions to meet this rising demand on our resources. The team is exploring several research opportunities that will lead to more efficient food production and processing and finding solutions to educate a new generation of workers to operate new technologies and solve problems for industries that are vital to our future.

ISU WORKS WITH KOREA ON NUCLEAR SAFETY RESEARCH

With a long-term solution for spent nuclear fuel disposal still in the distance, South Korea, which relies on nuclear energy for more than one-third of its electricity, is looking at pyro-processing as a means of dealing with its growing stockpile.

Idaho State University and the Korea Atomic Energy Research Institute have engaged in fundamental nuclear safety research that will be necessary to any pyro-processing facility that might be built. Research was done on pyro-processing safety and regulations, hazard evaluation, and safety system selection, and now is focused on a pre-conceptual facility design, including initial hazed analysis, shielding, and criticality safety and probabilistic risk analysis.

INDUSTRIAL ASSESSMENT CENTER HELPS REGIONAL BUSINESS SAVE ENERGY AND MONEY

The CAES Energy Efficiency Research Institute Industrial Assessment Center (CEERI-IAC) based out of Boise State University is a Department of Energy-sponsored program that offers businesses in the Mountain West in-depth energy assessments of their plant sites. An IAC team of students from Boise State, Idaho State or the University of Idaho meets the company representatives and takes tours where they collect data and make observations on how energy might be saved, and therefore, reduce energy costs. On average, a visit by an IAC team will save a regional business more than \$55,000 a year and pay for itself within 12 to 18 months. To date, the Center has helped approximately 60 companies become more energy efficient.

CAES BY THE NUMBERS

Investments:

- **\$3 million:** State of Idaho investment in CAES
- **\$6.84 million:** Idaho National Laboratory's investment in CAES infrastructure and operations Including:
 - **\$465,295** to support joint appointments with CAES affiliate universities
- **\$16.93 million:** Research program and other funding for CAES in FY2015 including:
 - **\$766,568** in CAES Laboratory Directed Research & Development funding for FY2015
 - **\$1,000,000** for two National Science Foundation Early Career Awards of \$500,000 each

Outreach:

- **1,558** visitors toured the CAES Idaho Falls facility in FY2015
- **1,891** visitors experienced the CAES Computer-Assisted Virtual Environment (CAVE) 3D data immersion research environment
- **237** CAES presentations, publications, and proceedings in FY2015
- **84** industry collaborations with CAES

Student Impact:

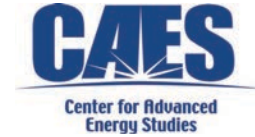
- **87** students from the CAES partner universities interned at Idaho National Laboratory in FY2015
- **249** of students worked on CAES-related projects in FY2015

**IGEM - Commerce**

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